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Explanation of the changes in accordance with PCT Article 34

New claims 1 to 23 are enclosed which are intended to replace the original claims 1 to 35 (original pages 26 to 33).

The new claim 1 comprises the features of the original claims 1 and 13.

Claims 2 to 4 correspond to the previous claims 2 to 4 in unchanged form. Furthermore, the new claim 5 corresponds to the previous claims 5 and 6; the new claim 6 corresponds in modified form to the previous claim 7; the new claim 7 corresponds to the previous claim 8; the new claim 8 corresponds to the previous claims 9 and 10; the new claim 9 corresponds to the previous claim 11; and the new claim 10 corresponds to the previous claim 12. Claims 11 to 14 correspond to the previous claims 15 to 18. The new claim 15 corresponds to the previous claims 19 to 21. The new claims 16 to 18 correspond to the previous claims 14 to 26. The new claim 19 corresponds to the previous claims 27, 33 and 34. The new claim 20 corresponds to the previous claims 28 to 30. Claims 21, 22 and 23 correspond to the previous claims 31, 32 and 35.

Furthermore, new description pages 4, 5, 6 have been filed which are intended to replace the previous pages 4 to 6.

Novelty and independent step

None of the documents quoted by the international search authority shows the feature combination of the new claim 1.

Document D1 (US 5,772,274 A) shows an electric motor with a transmission as the main drive for a top whose top elements are guided in a compulsory manner with respect to one another in a disadvantageous manner via a linkage.

Document D2 (US 2,632,670 A) shows a top whose roof elements are not pivotable with respect to one another, but can be displaced into one another in a translatory manner. The top pushed into one another can be pivoted around its main bearing into a stowing position by means of an electric drive as a main drive of the top. The individual pivoting of top elements is not possible in this process.

Document D3 (DE 198 47 983 C1) discloses a top having a complex hydraulic system for the pivoting of the individual top elements with the disadvantages quoted on page 3 in the application.

Document D4 (DE 199 32 500 A1) shows an electric-motor drive of a rear cover, but not a top having a plurality of pivot joints between the individual top elements, said pivot joints being directly controlled by the electric motor.

Since none of the quoted documents discloses the features of the new claim 1, its subject matter is novel in the sense of PCT Art 33 (2).

With respect to every single quoted document, but also with respect to any combination of the quoted documents, the originally disclosed object is still maintained of designing an apparatus for the activation of pivotable external elements of a vehicle which are top elements of a convertible vehicle such that it is improved with respect to a simple, flexibly designable and faster movement sequence on the pivoting of the external elements of the vehicle, with respect to a simpler design and to a lower weight.

The person of average skill in the art is not stimulated to the proposed solution by any of the cited references. Nor can the person of average skill in the art arrive at the claimed feature combination with the described advantages by a combination of the references.

Since inventive considerations are required for the finding of the feature combination of the new claim 1 which go beyond the mere application of general knowledge in the art, as is shown by the lack of such a solution despite the given need and despite a plurality of patent applications in this field, the new claim 1 is also based on an inventive step.

The dependent subordinate claims 2 to 23 must also be considered novel and inventive due to their dependency on the new independent claim 1.

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Enclosures

New claims 1 to 23

New description pages 4, 5, 6

This object is solved in accordance with the invention by the features named in the characterizing portion of claim 1.

If an apparatus for the actuation of a plurality of pivotal external elements of a vehicle, which are top elements of a top for a convertible vehicle and comprise at least foldable roof elements, with at least one pivot joint and drive being provided for the pivoting of the top elements with respect to one another and with respect to the vehicle body, is designed in accordance with the invention such that an electric motor is provided as the drive for pivot joints of connections between the top elements with respect to one another, said electric motor introducing a drive torque directly into a pivot joint, with in each case at least one pivot joint of different connections being controllable separately, this has the advantage that a much faster movement sequence can be realized due to the avoidance of system-caused dead times of a hydraulic drive and its lower stiffness.

Any desired flexible paths of movement can advantageously be realized by the use of drivable pivot joints which can be used as supporting pivot joints. Paths of movement can be realized with a drive in accordance with the invention which both satisfy the demands for sufficient headroom for passengers, e.g. in the back, and provide a protection against damage by an adjustable distance with respect to a height obstacle such as a garage ceiling.

The possibility is furthermore of advantage in a design in accordance with the invention of a drive for a pivotable outer element of a vehicle of making available comfort functions such as an automatic unit adapted to the spatial environmental conditions, optionally determined via a suitable sensor system, and by means

of which a top automatically closes or opens under predefined environmental conditions or events such as rain.

For instance, the top movement can be ideally adapted to the available headroom, for example, by a distance sensor system and associated control modes stored in the central electrical control unit.

Furthermore, the actuation of the at least one pivotable external element of a vehicle is possible via a remote control, which - with respect to a top - includes the folding open of only one front roof element and thus the creation of a targa-like open top.

The provision of an electric motor as the drive for the at least one pivot joint furthermore has the advantage that, using the motor current of the associated joint drive, a simple possibility of a jamming recognition is provided, with a top stop or a reversible top movement being able to be initiated for a top with a low reaction time and thus a high jamming protection being able to be realized. Furthermore, a simplified location of the problematic positions is possible in this manner.

Furthermore, possibilities of an emergency actuation or of a self-locking can also be provided.

Electric motors represent cost-favorable, simple and compact components which can be designed with low construction space requirements with the required motor forces and which can be used universally for different pivot joints and different pivotable external elements of a vehicle or sub-assemblies thereof.

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Furthermore, they provide all the possibilities for the control and regulation of the drives corresponding to the desired independent movements of the hinge points or pivot joints independently of the ambient temperatures, they are low in noise and they have a low maintenance requirement.

In an advantageous embodiment, an electric motor is associated with each connection of the top elements to one another or to the vehicle body via a pivot axle. In this manner, the highest flexibility can be realized with respect to an independent movement of the individual top elements.

In embodiments differing from this, it is, however, also conceivable that an electric motor is not associated with each pivot axle, but that one drive is used for more than one pivot axle. In practice, pivot axles, in particular pivot axles with an almost synchronous movement sequence, can be coupled in a simple manner, with a splitting of the drive of an electric motor to two or more rotating shafts being conceivable, or a compulsory guiding of one of the pivot axles.

CLAIMS

1. An apparatus for the actuation of a plurality of pivotable external elements of a vehicle (6, 7, 8, 15, 16) which are top elements of a top (1) of a convertible vehicle (2) and comprise at least foldable roof elements (6, 7, 8), of which at least one roof element (8, 15, 16) is pivotably connected to the vehicle body (9), with at least one pivot joint (10A, 10B, 10C, 10D, 10E, 10F, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B, 42, 43, 44, 45) and at least one drive (18, 19, 20, 21, 22) being provided for the pivoting of the top elements (6, 7, 8, 15, 16) with respect to one another or with respect to the vehicle body,
characterized in that
an electric motor (18, 19, 20, 21, 22) is provided as a drive for pivot joints (10A, 10B, 10C, 10D, 10E, 10F, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B, 42, 43, 44, 45) of connections at least between the top elements (6, 7, 8, 15, 16) to one another, said electric motor introducing a drive torque directly into an associated pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43), with at least one pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B, 42, 43) of different connections being separately controllable.
2. An apparatus in accordance with claim 1,
characterized in that
a torque of the electric motor (18, 19, 20, 21, 22) can be introduced by means of a flexible shaft (23) into a pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43).

3. An apparatus in accordance with either of claims 1 or 2, characterized in that
at least two pivot joints (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43) oppositely disposed with respect to a longitudinal axis of a vehicle are in each case connected to the electric motor (19, 20, 21, 22) by means of flexible shafts (23).
4. An apparatus in accordance with any one of the claims 1 to 3, characterized in that
at least some of a plurality of pivot joints (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43) are made of the same construction.
5. An apparatus in accordance with any one of the claims 1 to 4, characterized in that
the pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43) is driven by means of a transmission device (24), with the transmission device (24) being arranged between a lever (3) associated with a first external element of a vehicle (6) and a further lever (4) of a second external element of a vehicle (7).
6. An apparatus in accordance with claim 5, characterized in that
a flexible shaft (23) transmitting the torque of the electric motor (18, 19, 20, 21, 22) is rotatably connected to a screw (25) of the transmission device (24), said screw (25) being in engagement with a first gear (26) supported at one of the levers (4), said gear being in engagement with at least one

second gear (27) and being actively connected to the second lever (3).

7. An apparatus in accordance with any one of the claims 1 to 6, characterized in that
a position detection sensor (29) is arranged at the pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43).
8. An apparatus in accordance with claim 7, characterized in that
the position detection sensor (29) is made as a potentiometer, with a striker being provided in the transmission device (24) of the respective pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B, 17A, 17B; 42, 43) coaxially to the respective pivot axle (A1, A2, A3, A4, A5), the potentiometer (29) being arranged on said striker.
9. An apparatus in accordance with any one of the claims 1 to 8, characterized in that
an adjustable abutment (32), in particular an abutment made with a regulating screw (33), is provided at the pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B; 42, 43).
10. An apparatus in accordance with any one of the claims 1 to 9, characterized in that
the pivot joint (10A, 10B, 11A, 11B, 13A, 13B, 14A, 14B; 42, 43) is made rotatable by at least approximately 360°.
11. An apparatus in accordance with any one of the claims 1 to 10, characterized in that

an electric motor (18, 19, 20, 21, 22) is associated with each connection of the top elements (6, 7, 8, 15, 16) to one another or to the vehicle body (9) around a pivot axle (A1, A2, A3, A4, A5).

12. An apparatus in accordance with any one of the claims 1 to 11,
characterized in that
a connection of the top elements (6, 7, 8, 15, 16) to one another or to the vehicle body (9) is formed by at least one controllable pivot joint (10A, 10B; 42, 43) and by at least one passive pivot joint (10C, 10D, 10E, 10F; 44, 45), with the associated pivot axle (A4) of the connection being a pivot axle of a passive pivot joint (10C, 10D).
13. An apparatus in accordance with any one of the claims 1 to 12,
characterized in that
a plurality of electric motors (18, 19, 20, 21, 22) are connected to a central electrical control unit.
14. An apparatus in accordance with any one of the claims 1 to 13,
characterized in that
at least some of the electric motors each have a control unit which is connected in each case via a data bus to at least one further control unit for at least one electric motor.
15. An apparatus in accordance with any one of the claims 1 to 14,
characterized in that

three roof elements (6, 7, 8) are provided which can be folded together in S-shape such that a front roof element (6) is stowed in a folding position with an open top (2) rearwardly pivoted over a middle roof element (7) and a rear roof element (8) which lies below it and is likewise rearwardly pivoted with respect to its position with a closed top and, on an opening movement of the top (2), the front roof element (6) is pivoted upwardly and rearwardly around a first pivot axle (A1), the middle roof element (7) is pivoted around its rear second pivot axle (A2) and the rear roof element is pivoted rearwardly around its rear third pivot axle (A3), with the pivoting of the front roof element (6) selectively taking place substantially before or during or after the pivoting of the middle roof element (7) and of the rear roof element (8).

16. An apparatus in accordance with any one of the claims 1 to 15,
characterized in that
on an opening movement of the top (2), a clamp (15) is first raised for the release of a upwardly pivoting movement of a top storage well cover (16) and is lowered again after the putting up of the top storage well cover (16), after which the roof elements (6, 7, 8) are placed on the clamp (15).
17. An apparatus in accordance with any one of the claims 1 to 14,
characterized in that
three roof elements (6, 7, 8) can be folded such that, on an opening movement of the top (2), a middle roof element (7) is first pivoted around its rear pivot axle (A2) and a rear roof element (8) is pivoted rearwardly around its rear pivot axle

(A3); and, in an at least approximately horizontal position of the rear roof element (8), a front roof element (6) and the middle roof element (7) are placed down such that the middle roof element (7) is pivoted on the rear roof element (8) and at least approximately parallel thereto and the front roof element (6) is pivoted downwardly in respect to this into an at least approximately vertical position.

18. An apparatus in accordance with any one of the claims 1 to 17,
characterized in that
on an opening movement of the top (2), a top storage well cover (16) is first pivoted upwardly and, in the stowage position of the roof elements (6, 7, 8) is pivoted downwardly into an at least approximately horizontal position.
19. An apparatus in accordance with any one of the claims 1 to 18,
characterized in that
at least one external element of a vehicle is a cover element (16), in particular a top storage well cover or a gate cover, which can be raised from a closed position at least at one edge (16A) by pivoting by means of at least one drivable pivot joint (42, 43) and at least one associated drive (22) around an oppositely disposed edge (16B).
20. An apparatus in accordance with claim 19,
characterized in that
the at least one drivable pivot joint (42, 43) engages at a linkage (46) which is hingedly fixed at one end to the vehicle body (9) and is hingedly fixed at the other end to a region of the cover element (16) disposed in the longitudinal

direction of the vehicle spaced from a pivot axle (A5) of the cover element (16), with the linkage (46) being formed from two mutually connected levers (47, 48) which are preferably made with different lengths and with a connection of the levers (47, 48) to one another and at least one of the hinged connections to the cover element (16) or to the vehicle body (9) being formed with a drivable pivot joint (42, 43).

21. An apparatus in accordance with claim 20, characterized in that the cover element (16) can be latched in its closed position by pivoting the linkage (46) into a dead-center position or over-center position.
22. An apparatus in accordance with any one of the claims 19 to 21, characterized in that the at least one drivable pivot joint (42, 43) is designed manually adjustably for emergency activation in the deactivated state.
23. An apparatus in accordance with any one of the claims 19 to 22, characterized in that the cover element (16) is fixed to the vehicle body (9) at the edge (16B) associated with its pivot axle (A5) by means of at least one passive pivot joint (45), in particular a swan neck bearing (45).